CLAIMS

What is claimed is:

1. A device for the electrostimulation of body tissue through a stimulation electrode, comprising:

an energy storage means for providing electrical stimulation energy from an energy source;

an electrode connection for connecting the stimulation electrode for delivering electrical stimulation pulses to the body tissue;

a first switch with which the energy storage means is switchably connected to the electrode connection for the delivery of a stimulation pulse;

a means for monitoring stimulation outcome;

a short-circuit switch with which the electrode connection after delivery of the stimulation pulse is switchably at least indirectly connected to a ground potential in such a way that, in the case of a connected and implanted electrode line, a capacitance can be discharged by way of the body tissue and a ground electrode in such a way that a short-circuit current flows through the body tissue, wherein the capacitance includes at least one Helmholtz capacitance which is produced on the surface of the stimulation electrode in conjunction with surrounding body fluid or the body tissue; and

a control unit which is connected to at least the first switch and the short-circuit switch for switching over the respective switches and is adapted to separate the electrode line connection from the energy source after delivery of the stimulation pulse and at least indirectly connect the electrode line connection to the ground potential;

wherein the stimulation outcome monitoring means, at least after delivery of a stimulation pulse, is connected to the electrode connection and is adapted to detect a configuration in respect of time of a voltage at the capacitance after delivery of the stimulation pulse or of the short-circuit current or a parameter linked to one of said parameters.

2. The device of claim 1, wherein:

the stimulation outcome monitoring means is adapted to detect a characteristic drop in the configuration in respect of time of the detected voltage or a rise in the short-circuit current or a corresponding change in the linked parameter.

3. The device of claim 2, wherein:

the capacitance further comprises a coupling capacitor that is connected into circuit when the short-circuit switch is closed between the electrode connection ~~(36)~~ and the ground electrode.

4. The device of claim 3, wherein:

the coupling capacitor is arranged between the energy storage means and the electrode connection in such a way that the coupling capacitor is connected in series with the energy storage means when the first switch is closed.

5. The device of claim 4, wherein:

the stimulation outcome monitoring means is arranged and adapted to detect the voltage at the coupling capacitor.

6. The device of claim 5, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance at the electrode connection.

7. The device of claim 3, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance between the coupling capacitor and the electrode connection.

8. The device of claim 7, wherein:

the stimulation outcome monitoring means further comprises a differentiating member for differentiating the detected voltage or the detected current strength.

9. The device of claim 8, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects a drop in the detected voltage, which is above a predetermined limit value.

10. The device of claim 9, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means ascertains when the derivative of the detected voltage is below a threshold value.

11. The device of claim 10, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects when the derivative of the detected voltage, standardised to the detected voltage, is below a threshold value.

12. The device of claim 11, wherein:

a timer is connected to the stimulation outcome monitoring means, the timer being started with the delivery of a stimulation pulse and which ascertains the time to the detection of a stimulation outcome.

13. The device of claim 12, wherein:

the timer outputs a time signal corresponding to the time duration between stimulation pulse output and occurrence of the stimulation outcome and is connected to the control unit which is responsive to the time signal and causes setting of the strength of the stimulation pulse in dependence on the time signal.

14. The device of claim 13, wherein:

the ground electrode is formed by a housing of the device or a surface portion thereof.

15. The device of claim 14, wherein:
the energy storage means comprises at least one reservoir capacitor.

16. The device of claim 15, wherein:
the energy source is provided with a charge pump for charging the reservoir capacitor.

17. The device of claim 16, wherein:
the energy source includes switches which are so designed and connected to the capacitor that the reservoir capacitor is connected for charging to the charge pump and for the delivery of a stimulation pulse to the electrode connections.

18. The device of claim 1, wherein:
the capacitance further comprises a coupling capacitor that is connected into circuit when the short-circuit switch is closed between the electrode connection and the ground electrode.

19. The device of claim 3, wherein:
the coupling capacitor is arranged between the energy storage means and the electrode connection in such a way that the coupling capacitor is connected in series with the energy storage means when the first switch is closed.

20. The device of claim 4, wherein:
the stimulation outcome monitoring means is arranged and adapted to detect the voltage at the coupling capacitor.

21. The device of claim 19, wherein:
the stimulation outcome monitoring means is arranged and adapted to detect the voltage at the coupling capacitor.

22. The device of claim 18, wherein:

the stimulation outcome monitoring means is arranged and adapted to detect the voltage at the coupling capacitor.

23. The device of claim 1, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance at the electrode connection.

24. The device of claim 20, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance at the electrode connection.

25. The device of claim 21, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance at the electrode connection.

26. The device of claim 22, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance at the electrode connection.

27. The device of claim 18, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance between the coupling capacitor and the electrode connection.

28. The device of claim 6, wherein:

the stimulation outcome monitoring means is connected so as to detect at least one of: the current strength of the short-circuit current or the voltage at the capacitance between the coupling capacitor and the electrode connection.

29. The device of claim 27, wherein:

the stimulation outcome monitoring means further comprises a differentiating member for differentiating the detected voltage or the detected current strength.

30. The device of claim 28, wherein:

the stimulation outcome monitoring means further comprises a differentiating member for differentiating the detected voltage or the detected current strength.

31. The device of claim 29, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects a drop in the detected voltage, which is above a predetermined limit value.

32. The device of claim 30, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects a drop in the detected voltage, which is above a predetermined limit value.

33. The device of claim 31, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means ascertains when the derivative of the detected voltage is below a threshold value.

34. The device of claim 32, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means ascertains when the derivative of the detected voltage is below a threshold value.

35. The device of claim 9, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects when the derivative of the detected voltage, standardised to the detected voltage, is below a threshold value.

36. The device of claim 31, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects when the derivative of the detected voltage, standardised to the detected voltage, is below a threshold value.

37. The device of claim 33, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects when the derivative of the detected voltage, standardised to the detected voltage, is below a threshold value.

38. The device of claim 32, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects when the derivative of the detected voltage, standardised to the detected voltage, is below a threshold value.

39. The device of claim 34, wherein:

a threshold value detector is connected to the differentiating member in such a way that the stimulation outcome monitoring means detects when the derivative

of the detected voltage, standardised to the detected voltage, is below a threshold value.

40. The device of claim 1, wherein:

a timer is connected to the stimulation outcome monitoring means, the timer being started with the delivery of a stimulation pulse and which ascertains the time to the detection of a stimulation outcome.

41. The device of claim 37, wherein:

a timer is connected to the stimulation outcome monitoring means, the timer being started with the delivery of a stimulation pulse and which ascertains the time to the detection of a stimulation outcome.

42. The device of claim 39, wherein:

a timer is connected to the stimulation outcome monitoring means, the timer being started with the delivery of a stimulation pulse and which ascertains the time to the detection of a stimulation outcome.

43. The device of claim 40, wherein:

the timer outputs a time signal corresponding to the time duration between stimulation pulse output and occurrence of the stimulation outcome and is connected to the control unit which is responsive to the time signal and causes setting of the strength of the stimulation pulse in dependence on the time signal.

44. The device of claim 41, wherein:

the timer outputs a time signal corresponding to the time duration between stimulation pulse output and occurrence of the stimulation outcome and is connected to the control unit which is responsive to the time signal and causes setting of the strength of the stimulation pulse in dependence on the time signal.

45. The device of claim 42, wherein:

the timer outputs a time signal corresponding to the time duration between stimulation pulse output and occurrence of the stimulation outcome and is connected to the control unit which is responsive to the time signal and causes setting of the strength of the stimulation pulse in dependence on the time signal.

46. The device of claim 1, wherein:

the ground electrode is formed by a housing of the device or a surface portion thereof.

47. The device of claim 43, wherein:

the ground electrode is formed by a housing of the device or a surface portion thereof.

48. The device of claim 44, wherein:

the ground electrode is formed by a housing of the device or a surface portion thereof.

49. The device of claim 45, wherein:

the ground electrode is formed by a housing of the device or a surface portion thereof.

50. The device of claim 1, wherein:

the energy storage means comprises at least one reservoir capacitor.

51. The device of claim 46, wherein:

the energy storage means comprises at least one reservoir capacitor.

52. The device of claim 47, wherein:

the energy storage means comprises at least one reservoir capacitor.

53. The device of claim 48, wherein:

the energy storage means comprises at least one reservoir capacitor.

54. The device of claim 49, wherein:

the energy storage means comprises at least one reservoir capacitor.

55. The device of claim 50, wherein:

the energy source is provided with a charge pump for charging the reservoir capacitor.

56. The device of claim 51, wherein:

the energy source is provided with a charge pump for charging the reservoir capacitor.

57. The device of claim 52, wherein:

the energy source is provided with a charge pump for charging the reservoir capacitor.

58. The device of claim 53, wherein:

the energy source is provided with a charge pump for charging the reservoir capacitor.

59. The device of claim 54, wherein:

the energy source is provided with a charge pump for charging the reservoir capacitor.

60. The device of claim 55, wherein:

the energy source includes switches which are so designed and connected to the capacitor that the reservoir capacitor is connected for charging to the charge pump and for the delivery of a stimulation pulse to the electrode connections.

61. The device of claim 56, wherein:

the energy source includes switches which are so designed and connected to the capacitor that the reservoir capacitor is connected for charging to the charge pump and for the delivery of a stimulation pulse to the electrode connections.

62. The device of claim 57, wherein:

the energy source includes switches which are so designed and connected to the capacitor that the reservoir capacitor is connected for charging to the charge pump and for the delivery of a stimulation pulse to the electrode connections.

63. The device of claim 58, wherein:

the energy source includes switches which are so designed and connected to the capacitor that the reservoir capacitor is connected for charging to the charge pump and for the delivery of a stimulation pulse to the electrode connections.

64. The device of claim 59, wherein:

the energy source includes switches which are so designed and connected to the capacitor that the reservoir capacitor is connected for charging to the charge pump and for the delivery of a stimulation pulse to the electrode connections.